NOTAS SOBRE

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Noteworthy records of jaguar (*Panthera onca*), tayra (*Eira barbara*), and paca (*Cuniculus paca*) from southern Mexico

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ABSTRACT
Large and medium-sized mammal species are important from an ecological, conservation, and socioeconomic perspective. In southern Mexico, camera trapping in community-based wildlife monitoring projects provide records that extend the range of jaguar *Panthera onca* (Linnaeus 1758), tayra *Eira Barbara* (Linnaeus 1758), and paca *Cuniculus paca* (Linnaeus 1766) for the central area of State of Oaxaca. Also, these records extend the altitudinal distribution range of tayra and paca, and add the pine-oak forest as a habitat for them. Camera trapping in community-based wildlife monitoring projects is a valuable way to increase knowledge of the natural history of large and medium-sized mammals.

RESUMEN
Los mamíferos de talla mediana y grande destacan por su importancia ecológica, socioeconómica y de conservación. En el sur de México, fototrampeos usados en proyectos de monitoreo comunitario proveyeron evidencia fotográfica que extienden la distribución geográfica del jaguar *Panthera onca* (Linnaeus 1758), tayra *Eira Barbara* (Linnaeus 1758), y paca *Cuniculus paca* (Linnaeus 1766) para la región central del Estado de Oaxaca. Estos registros también extienden la distribución altitudinal de la tayra y la paca, e incorporan el bosque de pino-encino como hábitat para éstas. El fototrampeo usado en proyectos de monitoreo comunitario muestra ser de utilidad para incrementar el conocimiento de mamíferos de talla mediana y grande.

In southern Mexico, the State of Oaxaca has a remarkable diversity of mammals, comprising 216 terrestrial species which represent 43% of the mammal species existing in the country (Briones-Salas et al. 2015). Among this group, large and medium-sized species are important from an ecological, conservation, and socioeconomic perspective (Ojasti & Dallmeier 2000; Durán et al. 2012; Lavariega et al. 2017). Therefore, to obtain information on large and medium-sized species in the region, the Mexican government has promoted community-based wildlife monitoring as a

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way to acquire biodiversity data, and encourage conservation within the public (Padilla-Gómez et al. 2018). This wildlife monitoring is focused on felids, such as jaguars (*Panthera onca*), their potential prey (e.g. pacas [*Cuniculus paca*]), or other locally endangered species such as tayras (*Eira barbara*).

In Oaxaca, a Jaguar Conservation Unit and corridors of concern to connect jaguar populations have been identified (Sanderson et al. 2002; Rabinowitz & Zeller 2010). Throughout their range, jaguars have experienced a drastic decrease in their geographic distribution and population size, mainly due to habitat loss, fragmentation, and hunting of them and their prey (Sanderson et al. 2002; Quigley et al. 2017). In Mexico, the jaguar is listed as an endangered species (Secretaría de Medio Ambiente y Recursos Naturales 2010), while internationally it is considered as near threatened (Quigley et al. 2017). In Oaxaca, there are few jaguar records (Goodwin 1969; Hall 1981; Briones-Salas et al. 2012), mainly from Sierra Madre de Oaxaca, Planicie Costera del Pacífico, Sierra Madre del Sur de Oaxaca, and Depresión del Istmo de Tehuantepec subprovinces (Briones-Salas et al. 2015).

The tayra (*Eira barbara*) has a geographical distribution extending from both Atlantic and Pacific slopes in Mexico through southern Central America, reaching northern Argentina and Uruguay (Presley 2000; Cuarón et al. 2016). Tayras inhabit tropical and subtropical forests, secondary rainforests, gallery forests, gardens, plantations, cloud forests, and dry scrub forests; also, they can live near agricultural areas and human settlements (Emmons & Feer 1990). Tayras are commonly found below 1,200 m a.s.l., but there are records of them reaching altitudes of up to 2,400 m a.s.l. (Eisenberg 1989; Emmons & Feer 1990; Cuarón et al. 2016). In its entire geographic distribution, the species is considered of least concern, but with decreasing populations (Cuarón et al. 2016). In Mexico, it is categorized as an endangered species (Secretaría de Medio Ambiente y Recursos Naturales 2010).

The paca is a large and common rodent in lowland and midland tropical forests, from eastern and southern Mexico, reaching Brazil and Paraguay in South America (Pérez 1992; Emmons 2016). In Mexico, pacas inhabit forests in the Atlantic slope in San Luis Potosí, Veracruz, Oaxaca, and Chiapas states (Pérez 1992). Pacas live primarily in rainforests, but also in other vegetation types with rivers and standing waters (Pérez 1992; Emmons 2016). Their altitudinal range goes from sea level to 1,600 m (Pérez 1992).

Community-based wildlife monitoring in central Oaxaca has provided a large number of photographs from large and medium-sized mammals. Of these, records of jaguar, tayra, and paca are noteworthy because their altitudinal range, geographic distribution, and habitat are extended. In this work we describe new records for these species, contributing to the knowledge of their natural history.

Community-based wildlife monitoring projects consist of training local people in the use of camera-traps, global positioning systems, searching and recording footprints to

monitoring mammals. These projects are coordinated by the Mexican agency of protected areas, the Comisión Nacional de Áreas Naturales Protegidas, and currently, these projects are running in protected areas of North, Western, and Central Oaxaca. In the field, monitors in partnership with experts of the agency set, review, and download data from camera-traps (Padilla-Gómez et al. 2018). Subsequently, photographs and metadata are uploaded to the open-access platform Plataforma de Monitoreo Comunitario de la Biodiversidad (PMC).

As a part of the community-based wildlife monitoring, four sites located along the mountain chain at northern Central Valleys of Oaxaca were surveyed with camera traps between 2011 and 2018 (Fig. 1). One of the sites corresponds to the Área Destinada Voluntariamente a la Conservación La Cruz-Corral de Piedra (23.3 km^2; 17° 08' 51" to 17° 11' 24" N, and 96° 39' 12" to 96° 44' 20" W), with an altitudinal gradient ranging from 1,750 to 2,800 m a.s.l., temperate sub-humid climate, and covered by pine-oak forest and montane cloud forest (Comisión Nacional de Áreas Naturales Protegidas 2018). This site is adjoined with the Benito Juárez National Park (25.9 km^2). The second site is a community conservation area of unspecified extension (Martin et al. 2011) located in the municipality of Tlalixtac de Cabrera (17° 05' 29" N, 96° 34' 40" W). The area around this site is similar in physical characteristics to La Cruz-Corral de Piedra. The third and fourth sites are contiguous, and are also Áreas Destinadas Voluntariamente a la Conservación: Danii Idoo-Cerro Iglesia, municipality of Villa de Díaz Ordaz (17° 08' 51" to 17° 11' 24" N, 96° 39' 12" to 96° 44' 20" W) has 31.5 km^2 of extension, and El Campanario-Laacanloo Cruz, municipality of San Pablo Villa de Mitla (17° 06' 46" to 17° 09' 19" N, 96° 37' 35" to 96° 43' 09" W) has 49.0 km^2.

The climate in the area is temperate semi-arid in the lowlands, and temperate sub-humid in the mountain tops (Instituto Nacional de Estadística, Geografía e Informática 1998). Both sites are covered by pine forests, oak forests, pine-oak forests, scrub, and deciduous forests (Instituto Nacional de Estadística, Geografía e Informática 2015). To record large and medium-sized mammals, 30 camera traps were deployed in La Cruz-Corral de Piedra (seven devices), Tlalixtac de Cabrera (eight devices), Danii Idoo-Cerro Iglesia (eight devices), and El Campanario-Laacanloo Cruz (seven devices). Camera traps were set in trees to operate 24 h, at a mean of 30 cm above ground. Based on the annual budget, camera traps worked between one to six months per year (Padilla-Gómez et al. 2018).

Between 2012 and 2015, 13 jaguar photographs and videos were obtained in four camera trap stations (Fig. 2; Table 1). Records correspond to two individuals, a male and a female, photographed between 11.49 h and 16.00 h. These sites have pine-oak forests in an altitudinal gradient that goes from 1,876 m to 2,719 m a.s.l., and there are at no more than 33 km from the capitol of Oaxaca (Fig. 1). Most records (85%) occurred within the community conservation area of Tlalixtac de Cabrera, whereas

the other records correspond to the Área Destinada Voluntariamente a la Conservación of San Pablo Villa de Mitla y Villa Díaz Ordaz. On the other hand, tayras and pacas were recorded in the pine-oak forest of the Área Destinada Voluntariamente a la Conservación La Cruz-Corral de Piedra, Etla, between 2,700 and 2,800 m a.s.l. (Figs. 3 and 4; Table 1). The tayra records correspond to one photograph taken at 17.33 h in June 2014, whereas the pacas were recorded between May 2013 and July 2016 a total of 20 times in the same camera-trap station. The paca was photographed between 19.00 and 05.06 hrs (Table 1).

The jaguar photographs presented here expand the geographical distribution of the species from the Atlantic slope to the central region of Oaxaca (Quigley et al. 2017). Also, the jaguar records are among the highest in elevation recorded for the species (Perovic and Herrán 1998; Ceballos et al. 2011; Briones-Salas et al. 2012; Di Bitteti et al. 2016; Lodeiro-Ocampo et al. 2016; Quigley et al. 2017). In Oaxaca, most of the jaguar records come from north and east regions (Briones-Salas et al. 2012, 2015), both considered parts of a jaguar conservation units (Rodríguez-Soto et al. 2011; de la Torre et al. 2018) or in areas with potential for maintaining a jaguar population (Jedrzejewski et al. 2018). However, the mountains of central Oaxaca have been largely ignored as relevant for jaguars due to unknow species presence and because the region has been classified as low suitable habitat or marginal for jaguars in species distribution modeling studies (Rodríguez-Soto et al. 2011; Briones-Salas et al. 2012; Cuyckens et al. 2017). Mountains of the central region are in close contact with those of the north region, suggesting the jaguars photographed in central region pertain to the northern population, which is extending to the central region.

The new records expand the altitudinal range of tayra and add the pine-oak forest as a habitat for the species (Eisenberg 1989; Emmons & Feer 1990; Cuarón et al. 2016). Also, these tayra records confirm their presence in central Oaxaca, where there were no previous records (Briones-Salas et al. 2015), but maps have included them (Cuarón et al. 2016). The sites of the paca records presented here are not contemplated as the current geographical distribution for paca by the IUCN maps (Emmons 2016); however, distribution models for this species predicted suitable conditions (Ceballos et al. 2006). The nearest records of tayra and paca, recorded by tracks, are located 35 km at northeastern and at 2,590 m a.s.l. (Cruz-Espinoza et al. 2012). The presence of the paca at high elevation and in a pine-oak forest may be because the sites have streams (pers. obs.), a condition that can favor the presence of pacas (Pérez 1992; Emmons 2016). In addition of paca record by Cruz-Espinoza et al. (2012), we highlight the extent of the paca altitudinal range by nearly 1,000 m of the known, and the pine-oak forest as habitat for the species (Pérez 1992).

As observed by the information presented in this work, community-based wildlife monitoring incorporating camera-trapping is valuable as a way to increase knowledge of the natural history of large and medium-sized mammals. It has the advantage of

continuous monitoring for several years, allowing the recording of this sort of species. Also, involving local people provides a cost-effective method for biological monitoring, especially for remote regions, besides, it is a good way to empower people on the management of their natural resources (Dinerstein et al. 2013). While more work is needed on biodiversity conservation in such a biologically diverse state as Oaxaca, we believe that community-based wildlife monitoring is an effective method to achieve these conservation goals.

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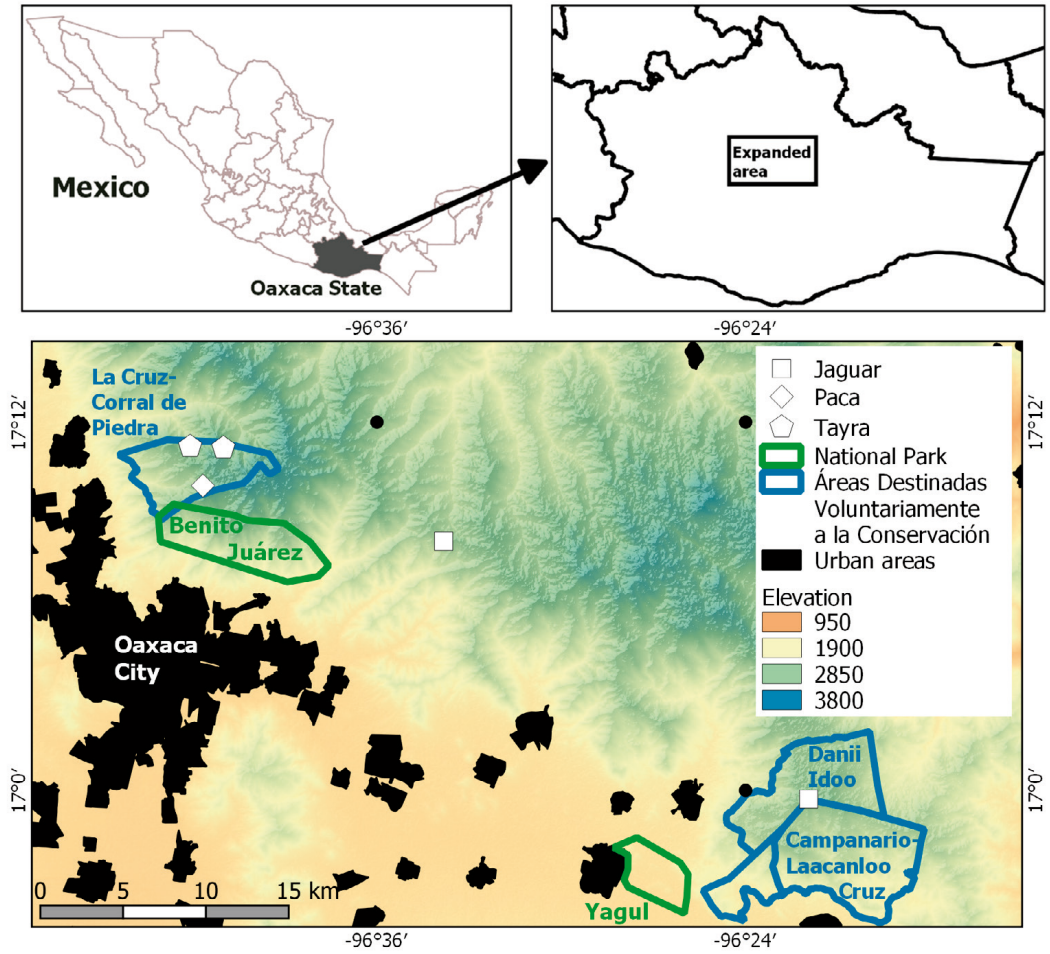

Figure 1. Location of recordings of medium and large-sized mammals in Central Oaxaca, Mexico.

Figure 2. Jaguar photographed in the Área Destinada Voluntariamente a la Conservación Arroyo del Aguacatal-Tlalixtac de Cabrera, mountains of Central Oaxaca, Mexico.

Figure 3. Tayra recorded in the Área Destinada Voluntariamente a la Conservación La Cruz Corral de Piedra, mountains of Central Oaxaca, Mexico.

Figure 4. Paca photographed in the Área Destinada Voluntariamente a la Conservación La Cruz Corral de Piedra, mountains of Central Oaxaca, Mexico.

Table 1. Photographic records of jaguar, tayra and paca in mountains of Central Oaxaca, Mexico.

Species	Date	Time	Site	Vegetation type	Elevation	Catalogue number
Jaguar	April 2012	22.06	El Campanario-Laacanloo Cruz	Pine-oak forest	2714	PCM:13309
Jaguar	August 2013	11.49	Danii Idoo	Oak-pine forest	2585	PCM:10508
Jaguar	May 2015	23.03	Arroyo del Aguacatal-Tlalixtac de Cabrera	Pine-oak forest	2085	PCM:14005
Jaguar	December 2014; January 2015; April 2015	01.00, 02.22, 18.37, 18.40, 19.24, 23.57	La Lima-Tlalixtac de Cabrera	Tropical deciduous forest	1920	PCM:10318, 10319, 10324, 10325, 12377, 15622
Jaguar	July 2014, November 2014, December 2014, April 2015	16.02, 16.35, 17.27, 17.45	La Manzanita-Tlalixtac de Cabrera	Pine-oak forest	2300	PCM:12801, 12488, 12518, 15450
Tayra	June 2014	17.33	La Cruz-Corral de Piedra	Pine-oak forest	2800	PMCB:11134
Paca	May 2013, October 2013, December 2014, January 2015, March 2015, May 2015, July 2016	00.09, 00.38, 00.41, 00.44, 00.52, 01.08, 01.21, 01.22, 02.36, 03.08, 02.50, 04.51, 05.06, 19.11, 19.20, 20.02, 20.34, 21.43, 22.30, 23.49	La Cruz-Corral de Piedra	Pine-oak forest	2800	PMCB:11501, 13622, 9695, 11501, 11599, 11600, 11603, 11606, 11608, 11609, 11611, 11612, 11613, 11615, 11616, 11624, 11628, 11633, 11647, 11655, 11659

LITERATURE CITED

Briones-Salas, M., M. C. Lavariega, & I. Lira. 2012. Distribución actual y potencial del jaguar (*Panthera onca*) en Oaxaca, México. Revista Mexicana de Biodiversidad 83:246–257.

Briones-Salas, M., M. Cortés-Marcial, & M. C. Lavariega. 2015. Diversidad y distribución geográfica de los mamíferos terrestres del estado de Oaxaca, México. Revista Mexicana de Biodiversidad 86:685–710.

Ceballos, G., S. blanco, C. González, & E. Martínez. 2006. *Cuniculus paca* (Tepezcuincle). Distribución potencial. Extraído del proyecto DS006 Modelado de la distribución de las especies de mamíferos de México para un análisis GAP. Instituto de Biología, Universidad Nacional Autónoma de México, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México.

Ceballos, G., C. Chávez, R. List, H. Zarza, & R. Medellín. 2011. Jaguar Conservation and Management in México: Case Studies and Perspectives. Alianza WWF-Telcel / Universidad Nacional Autónoma de México, México.

Comisión Nacional de Áreas Naturales Protegidas. 2018. Áreas Destinadas Voluntariamente a la Conservación, May 2018, 1st edition. Comisión Nacional de Áreas Naturales Protegidas, México.

Cruz-Espinoza, A., G. E. González-Pérez, & R. Vázquez. 2012. Nota de la variación en la riqueza específica de mamíferos entre áreas de conservación y de aprovechamiento forestal en la Sierra Madre de Oaxaca. Therya 3:327–332.

Cuarón, A. D., F. Reid, K. Helden, & J. F. González-Maya. 2016. *Eira barbara*. The IUCN Red List of Threatened Species 2016: e.T41644A45212151.

Cuyckens, G. A. E., P. G. Perovic, & M. Herrán. 2017. Living on the edge: regional distribution and retracting range of the jaguar (*Panthera onca*). Animal Biodiversity and Conservation 40:71–86.

de la Torre, J. A., J. F. González-Maya, H. Zarza, G. Ceballos, & R. A. Medellín. 2018. The jaguar's spots are darker than they appear: assessing the global conservation status of the jaguar *Panthera onca*. Oryx 52:300–315.

Di Bitteti, M. S., et al. 2016. Estado de conservación del jaguar en la Argentina. El jaguar en el siglo XXI. La perspectiva continental (R. A. Medellín, J. A. de la Torre, C. Chávez, H. Zarza, & G. Ceballos, eds.). Fondo de Cultura Económica, UNAM, Instituto de Ecología, Mexico City.

Dinerstein, E. et al. 2013. Enhancing conservation, ecosystem services, and local livelihoods through a wildlife premium mechanism. Conservation Biology 27:14–23.

Durán, E., J. Robson, M. Briones-Salas, D. B. Bray, & F. Berkes. 2012. Mexico: Wildlife conservation on community conserved lands in Oaxaca. Protected landscapes and wild biodiversity (N. Dudley & S. Stolton, eds.). Vol. 3. Values of protected landscapes and seascapes, IUCN, Gland.

Eisenberg, J. F. 1989. Mammals of the Neotropics. The Northern Neotropics. The University of Chicago Press, Chicago and London.

Emmons, L. 2016. *Cuniculus paca*. The IUCN Red List of Threatened Species 2016: e.T699A22197347.

Emmons, L., & F. Feer. 1990. Neotropical Rainforest Mammals: a Field Guide. University of Chicago Press, Chicago, USA and London.

Goodwin, G. G. 1969. Mammals from the State of Oaxaca, Mexico, in the American Museum of Natural History. Bulletin of the AMNH 141:1–271.

Hall, R. 1981. The Mammals of North America. 2nd edition. John Wiley and Sons, New York.

Instituto Nacional de Estadística, Geografía e Informática. 1998. Climas de la República Mexicana de acuerdo a la clasificación de Koppen modificada por García. Instituto Nacional de Estadística, Geografía e Informática, México.

Instituto Nacional de Estadística, Geografía e Informática. 2015. Uso de suelo y vegetación serie VI. Instituto Nacional de Estadística, Geografía e Informática, México.

Jędrzejewski, W. et al. 2018. Estimating large carnivore populations at global scale based on spatial predictions of density and distribution–Application to the jaguar (*Panthera onca*). PloS one 13:e0194719.

Lavariega, M. C., N. Martín-Regalado, A. G. Monroy-Gamboa, & M. Briones-Salas. 2017. Estado de conservación de los vertebrados terrestres de Oaxaca, México. Ecosistemas y Recursos Agropecuarios 4:135–146.

Lodeiro-Ocampo, N., N. A. Nigro, & F. Falke. 2016. Seasonal use of the upper montane forests by the jaguar in northern Argentina. Cat News 63:4–5.

Martin, G. J., C. I. Camacho, C. A. Del Campo, S. Anta, F. Chapela, & M. A. González. 2011. Indigenous and community conserved areas in Oaxaca, Mexico. Management of Environmental Quality: An International Journal 22:250–266.

Ojasti, J., & F. Dallmeier. 2000. Manejo de Fauna Silvestre Neotropical. Washington D.C.:SI/MAB Series #5. Smithsonian Institution/MAB Biodiversity Program, Washington, D. C.

Padilla-Gómez, E., M. C. Lavariega, P. A. García-Santiago, J. Santiago-Velasco, & R. O. Méndez-Méndez. 2018. An open access platform for camera-trapping data. Biodiversity Informatics 13:1–10.

Pérez, M. 1992. *Agouti paca*. Mammalian Species 404:1–7.

Perovic, P. G. & M. Herrán. 1998. Distribución del jaguar *Panthera onca* en las provincias de Jujuy y Salta, noroeste de Argentina. Mastozoología Neotropical 5:47–52.

Presley, S. J. 2000. *Eira barbara*. Mammalian Species 2000:1–6.

Quigley, H., R. Foster, L. Petracca, E. Payan, R. Salom, & B. Harmsen. 2017. –*Panthera onca*. The IUCN Red List of Threatened Species 2017:e.T15953A50658693.

Rabinowitz, A., & K. A. Zeller. 2010. A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. Biological Conservation 143:939–945.

Rodríguez-Soto, C. et al. 2011. Predicting potential distribution of the jaguar (*Panthera onca*) in Mexico: identification of priority areas for conservation. Diversity and Distributions 17:350–361.

Sanderson, E. W. et al. 2002. Planning to save a species: the jaguar as a model. Conservation Biology 16:58–72.

Secretaría de Medio Ambiente y Recursos Naturales. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-especies nativas de México de flora y fauna silvestres-categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-lista de especies en riesgo. Diario Oficial de la Federación 2454:1–77.